

Industrial LINAC at NDT laboratory and its potential applications

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Infrastructure

Lambda building

Bunker (radiation protection)

Accelerator:

Principle of operating

Beam parameters

Manipulators

Applications

Radiography

Semiconductors

Gemstones

Polymers

Utilization, sterylization

Future plans

Tomography, electron beam applicators

Lambda Building



Bunker

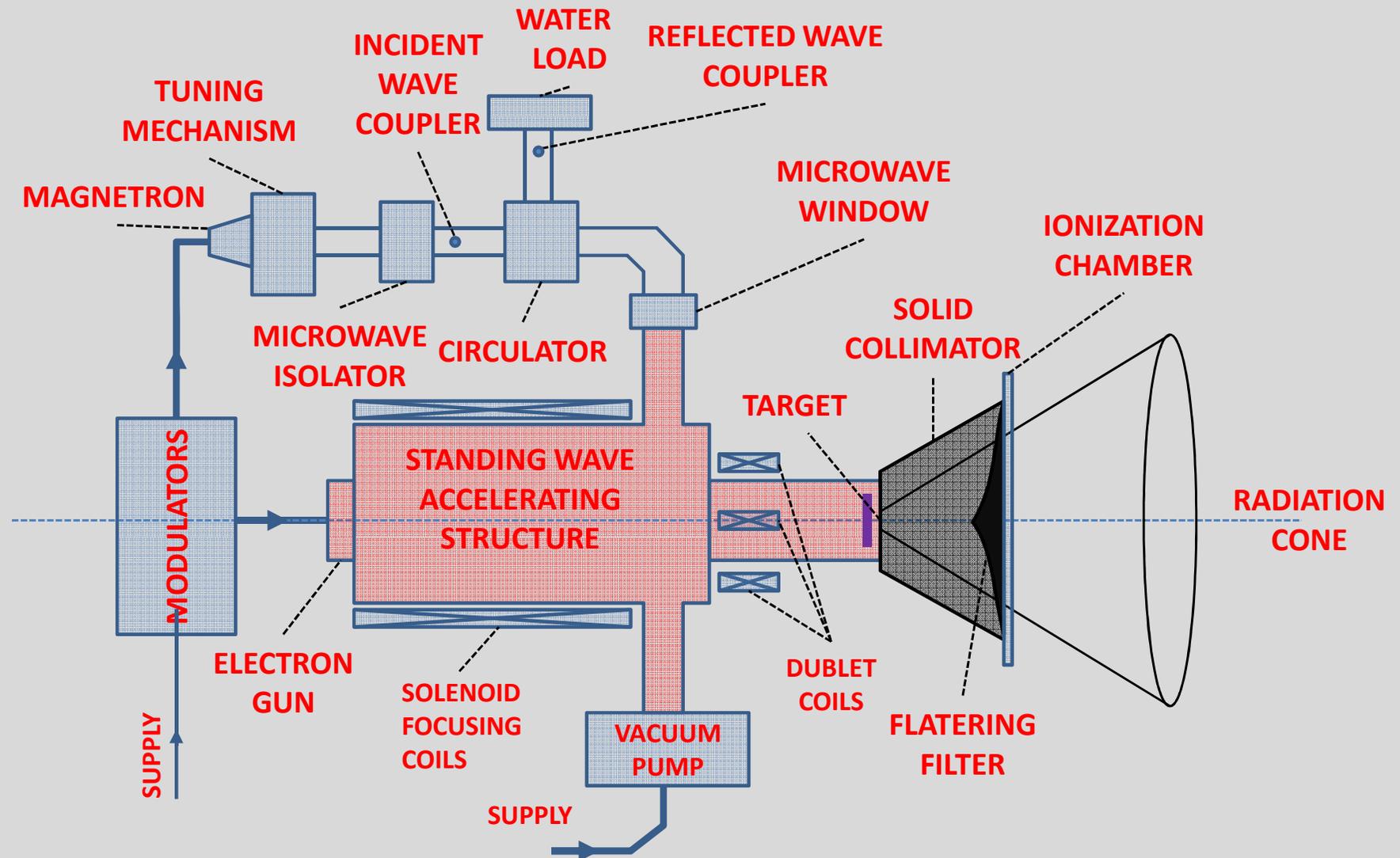


Industrial accelerator station



Produced by National Centre for Nuclear Research - Świerk

Principle of operating



Parameters

X-RAY BEAM ENERGY	dual: 6 or 9 MV
X-RAY BEAM DOSE RATE	max. 20 Gy/min for 9 MeV at the distance 1 m from target
RADIATION STABILITY	≤ 2% during the period of 8 hours
FOCAL SPOT SIZE	2 mm
RADIATION LEAKAGE	≤ 0,1 %
X-RAY BEAM ASYMMETRY	± 5%
X-RAY BEAM FLATNESS	better than 10% within 80% of beam width around axis
radiation	
RADIOGRAPHIC QUALITY	1-2T or better
HALF-VALUE LAYER (9 MV)	30,0 mm for STEEL 15,2 mm for LEAD
PRIMARY COLLIMATOR CONE	28°
IRRADIATION FIELD DIAMETER	50 cm in the plane located 1 m from the target

Manipulators

Accelerator (2 axes)

Vertical: $Z = 1,5 \text{ m}$

Tilting: $\alpha: \pm 22,5^\circ$

Object (3 axes)

Horizontal: $X, Y = 1 \text{ m}$

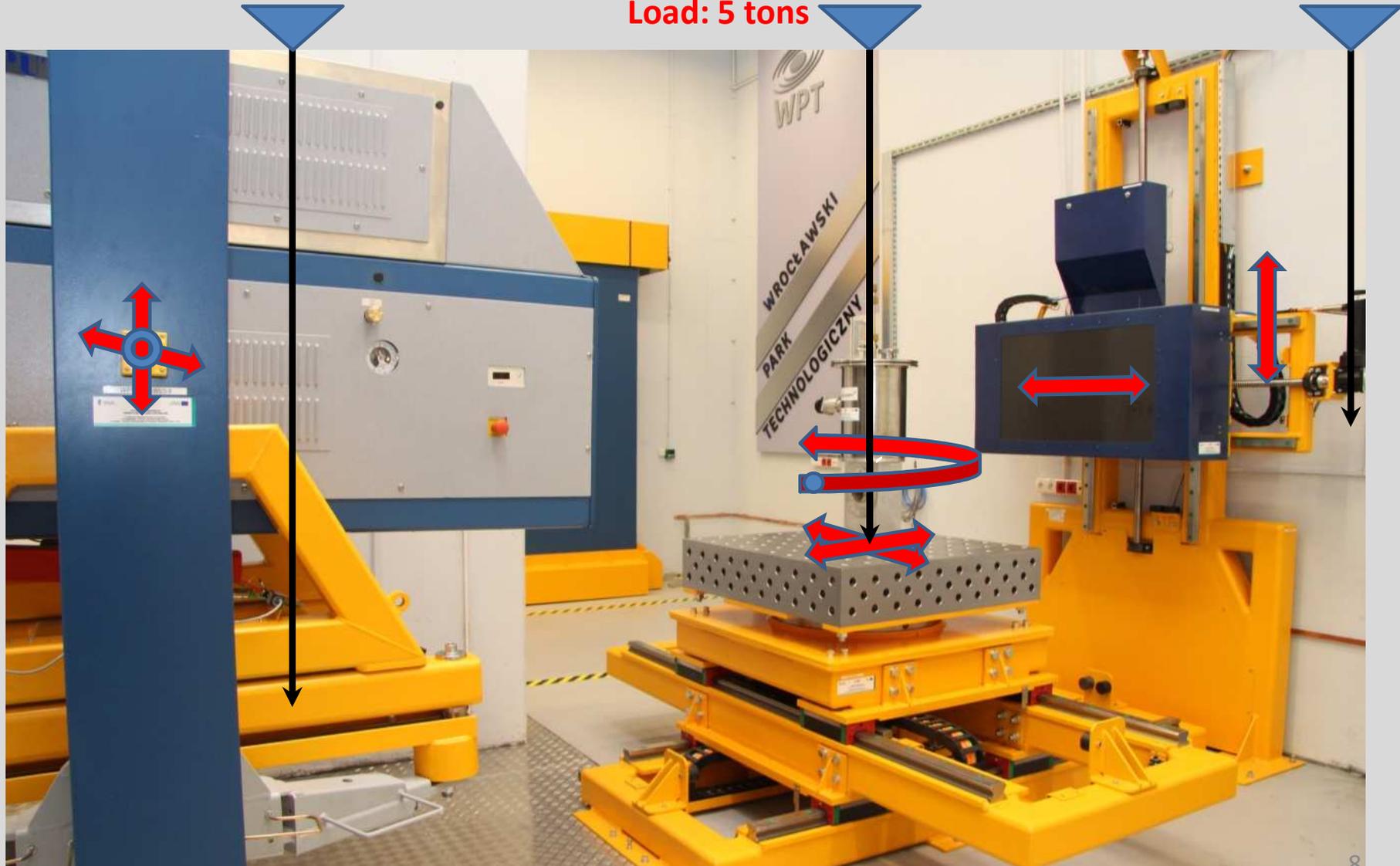
Rotating: 360°

Load: 5 tons

Detector (2 axes)

Vertical: $Z = 1,5 \text{ m}$

Horizontal: $X = 0,6 \text{ m}$

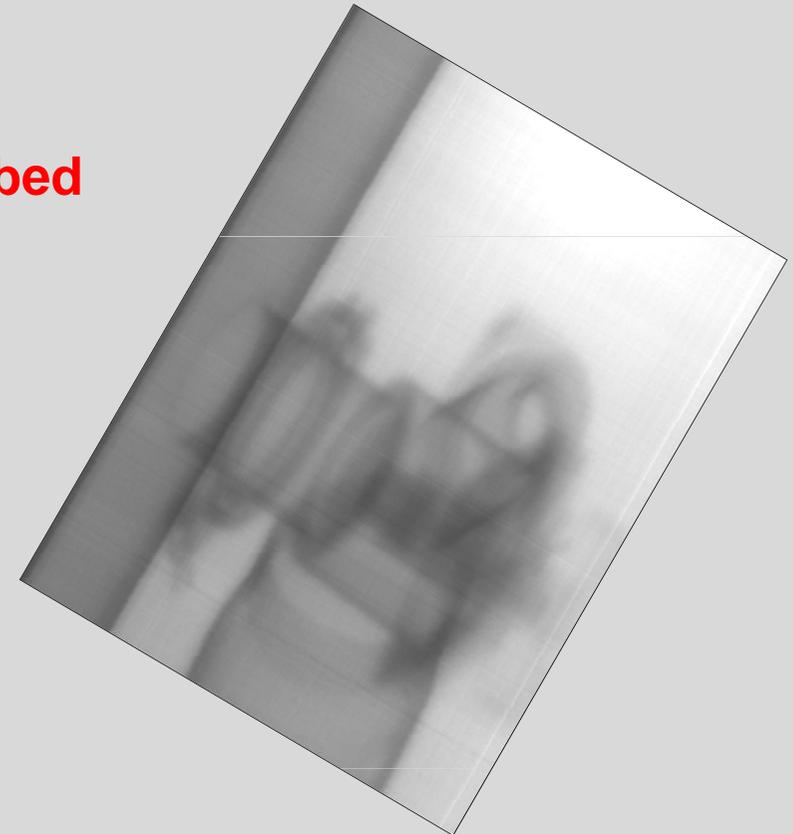


Radiography

Radiography - imaging technique

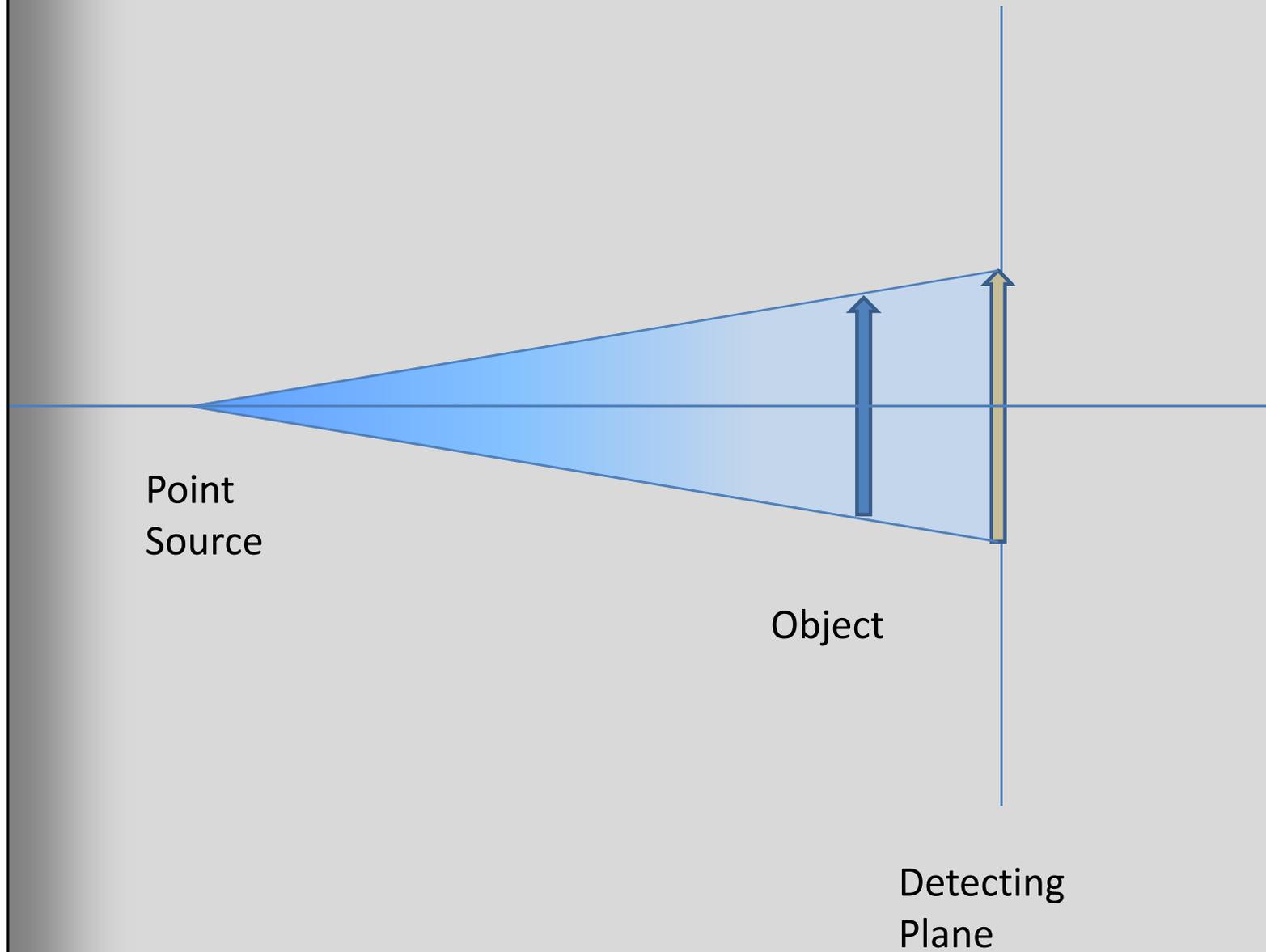
Certain amount of photons is absorbed by the object.

Detector (film) illustrates the internal structure (density distribution).

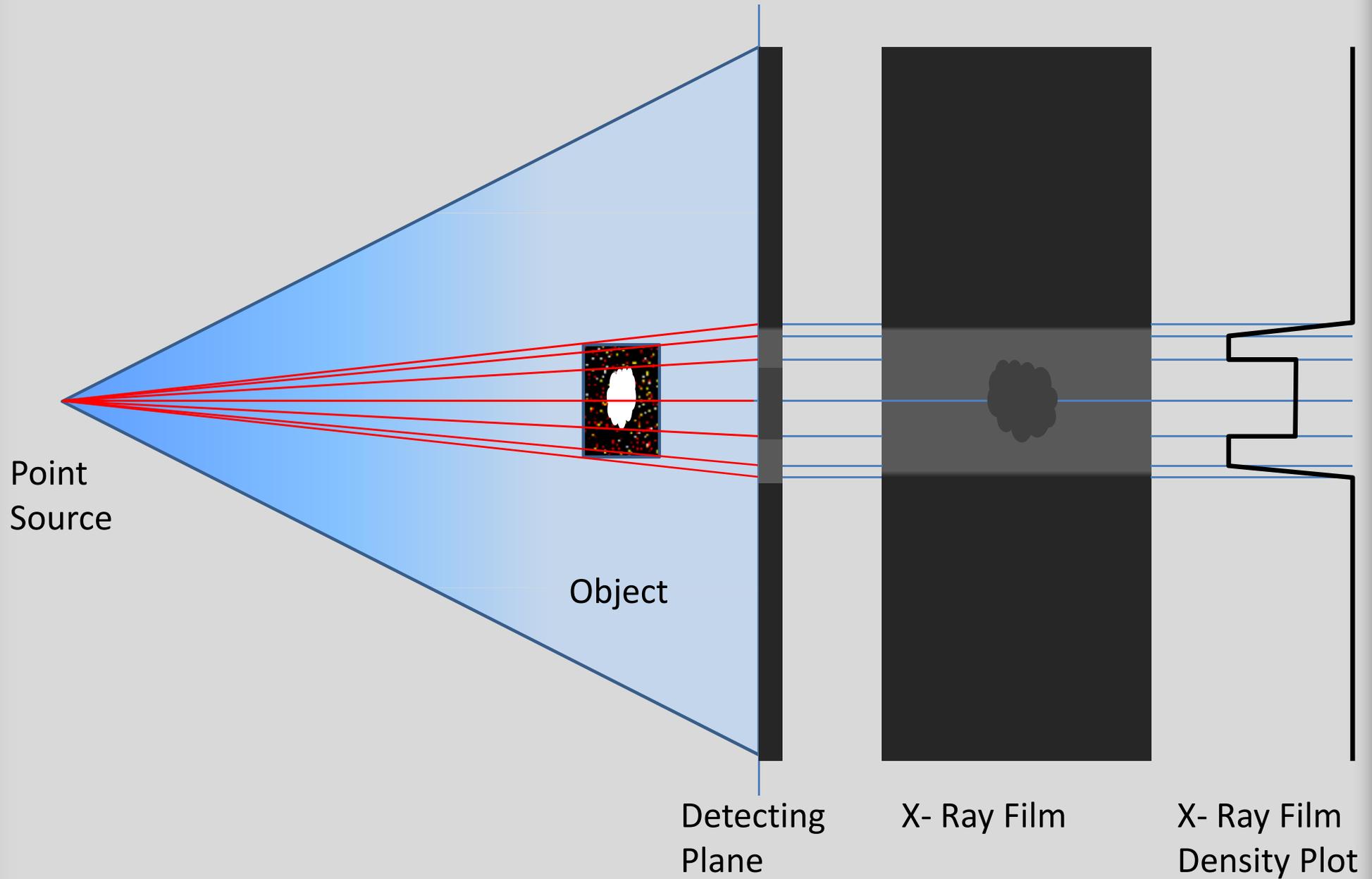


Subject of studies are:
castings, bridges spans, cointainers
and welds

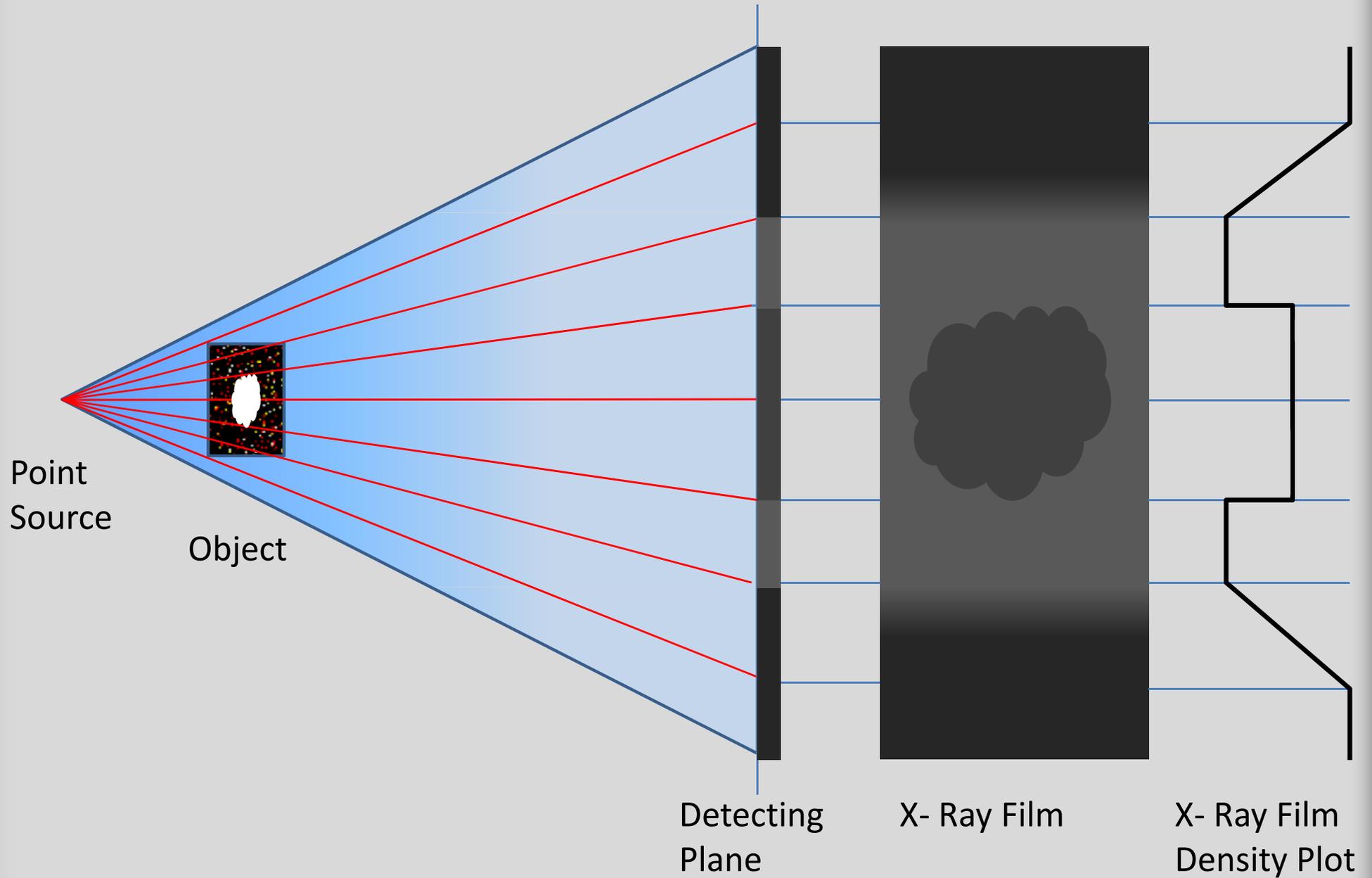
Radiography:



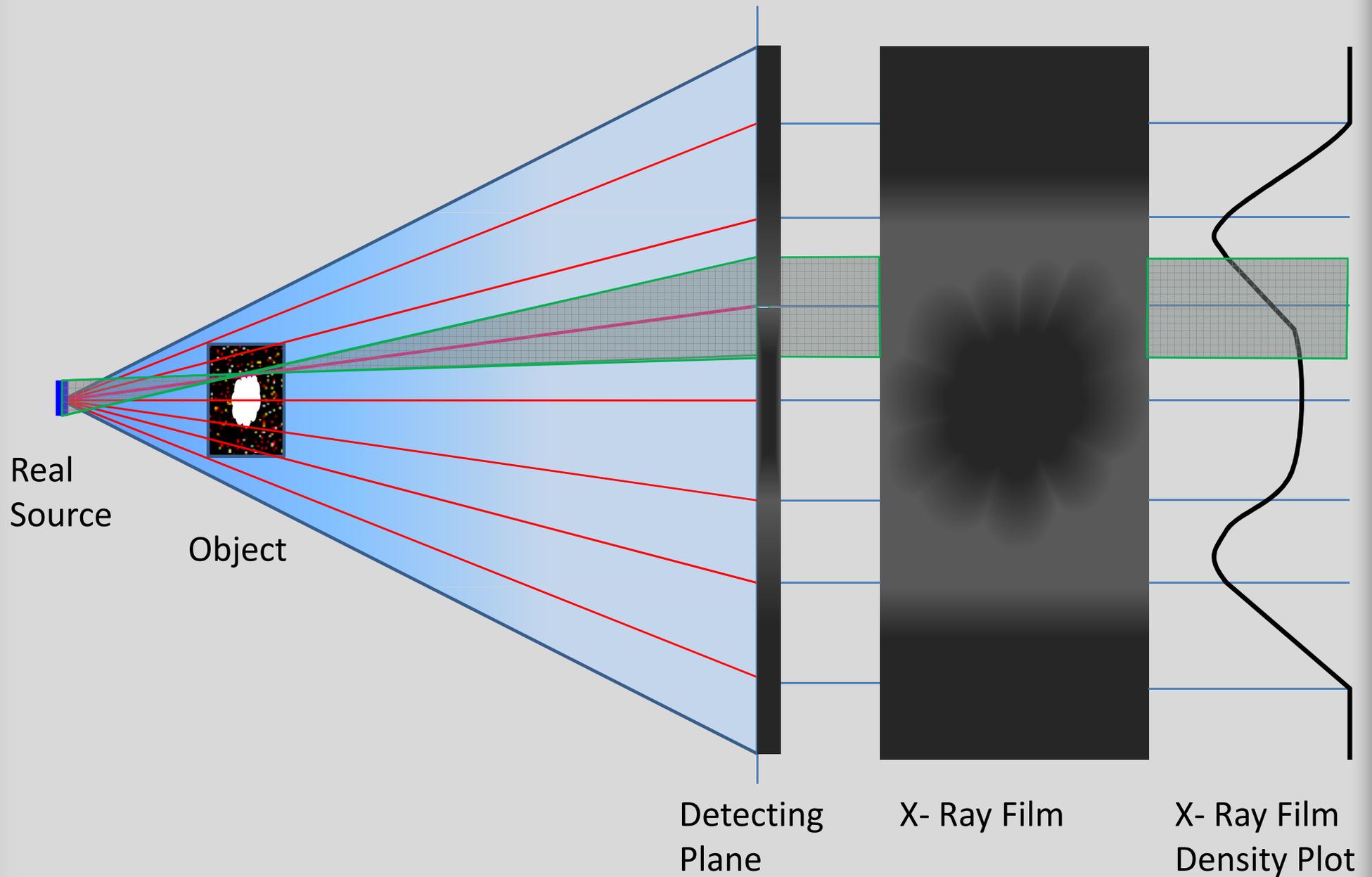
Radiography



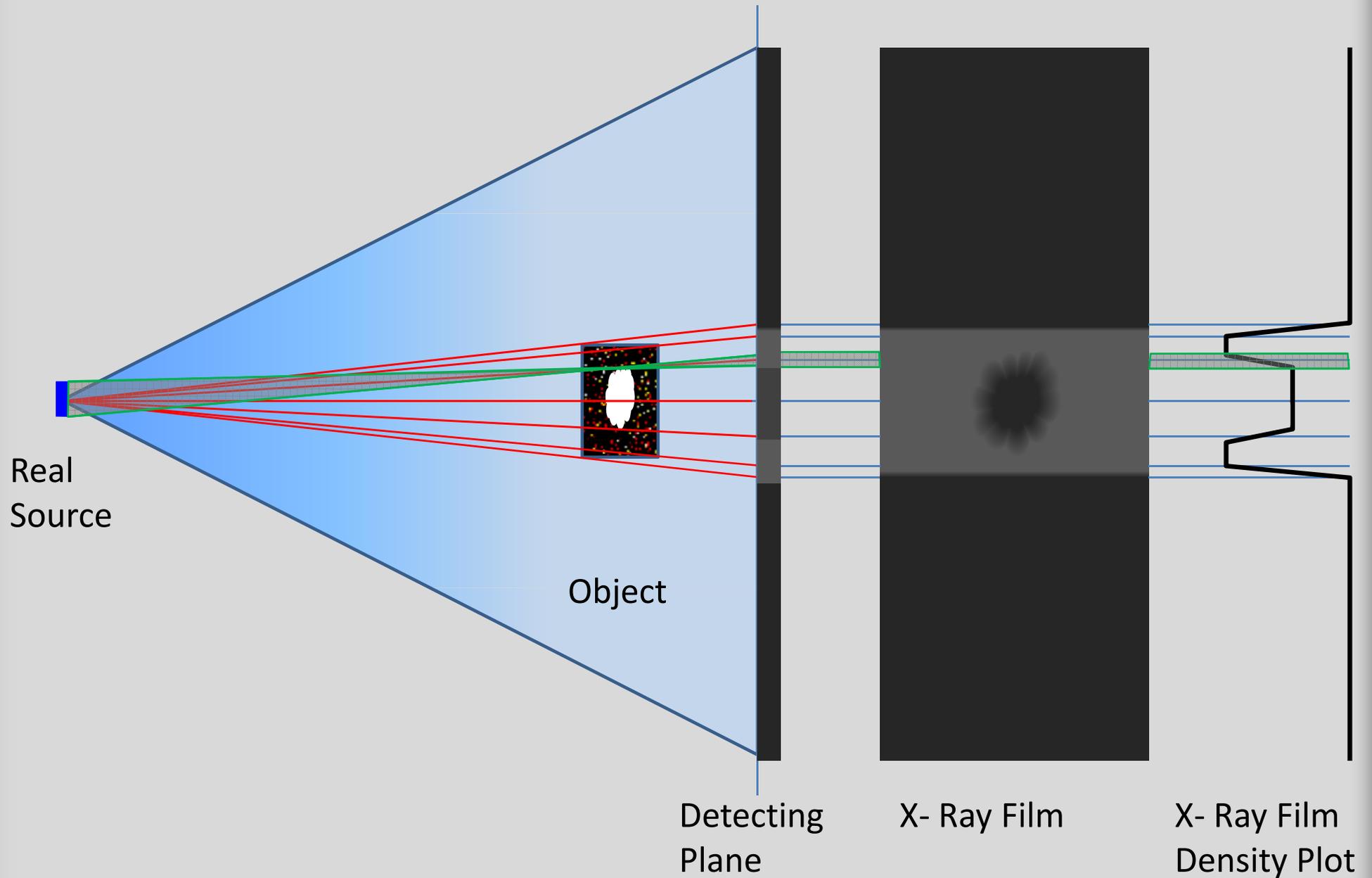
Radiography



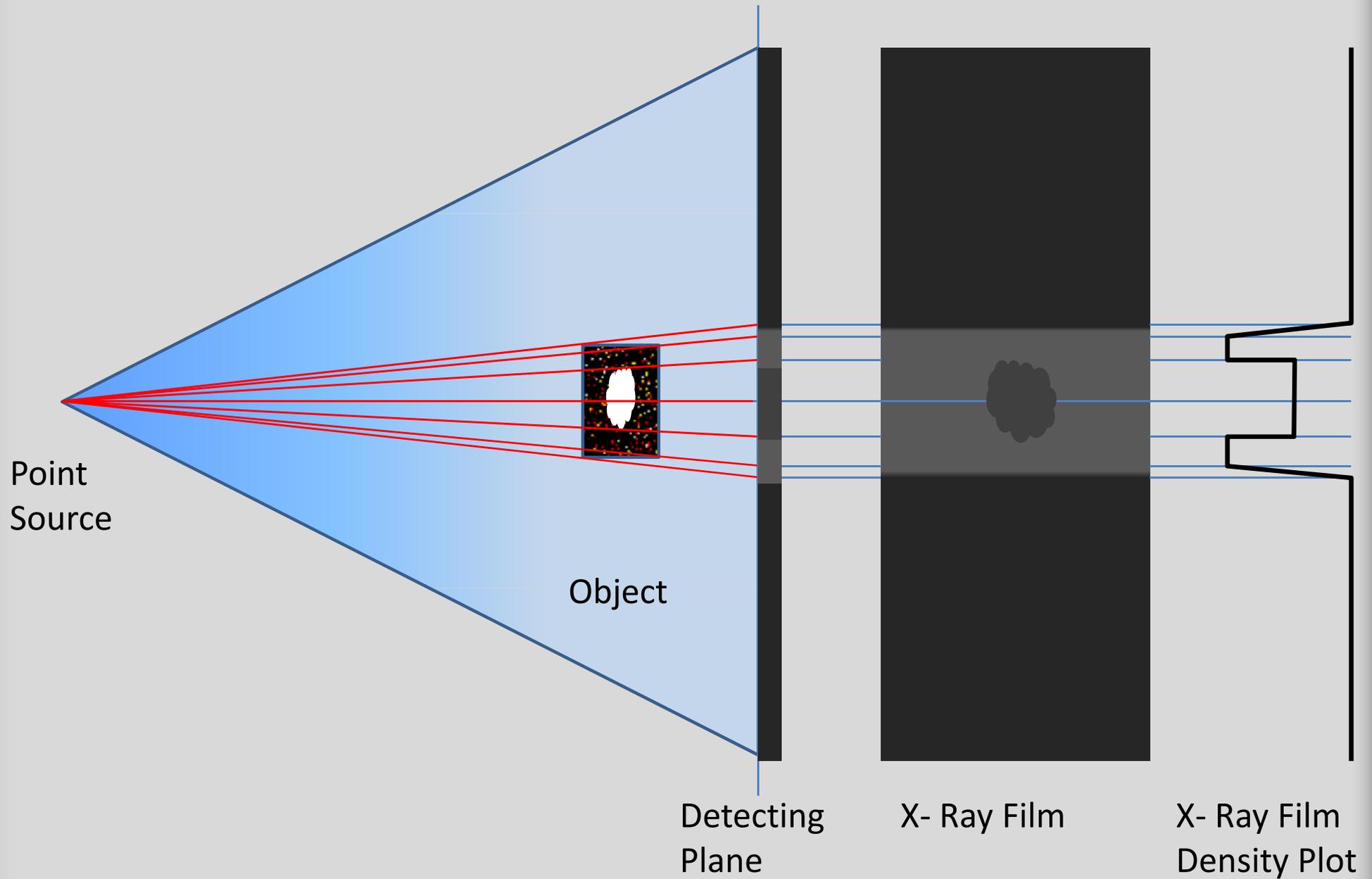
Radiography



Radiography

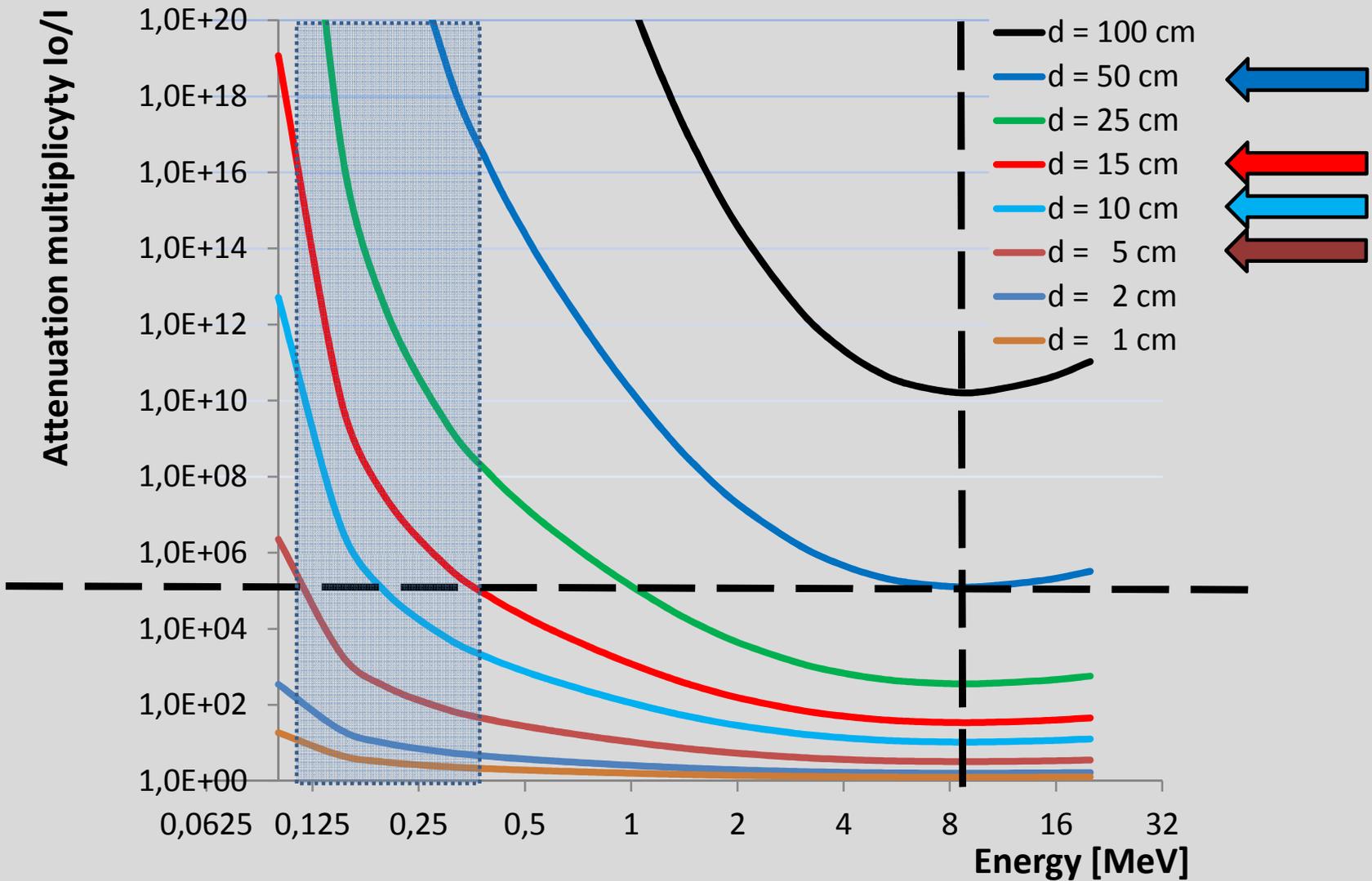


Radiography



Radiography

$$I_0/I = \exp[(\mu/\rho)d]$$



Electronics

Diodes or transistors after being irradiated with electrons improve their **switching speed**

Advantages:

Switching speed increases (But it can be recovered by annealing)

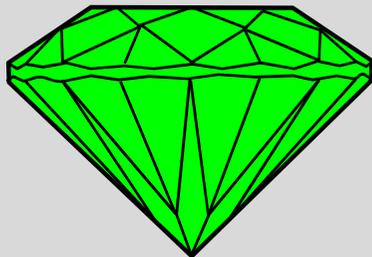
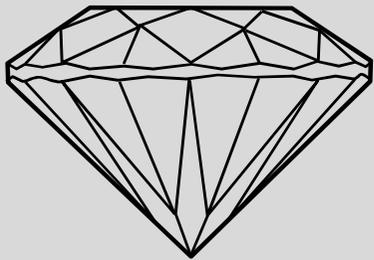
Also finished products can be irradiated

Jewellery

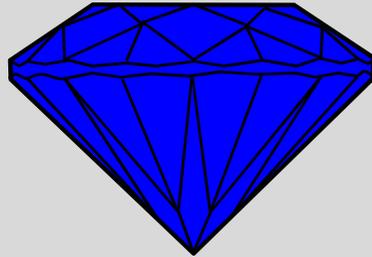
Gemstones irradiated with electrons change their color

Examples

Diamond

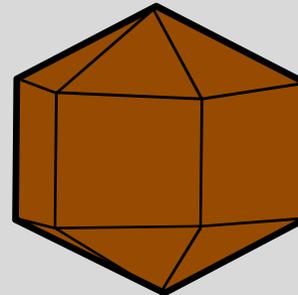
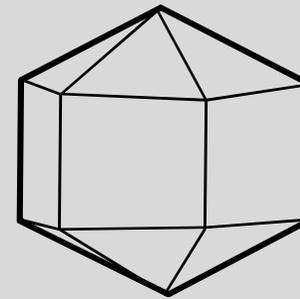


GREEN

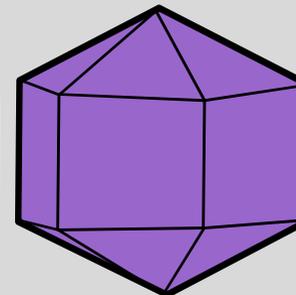


BLUE

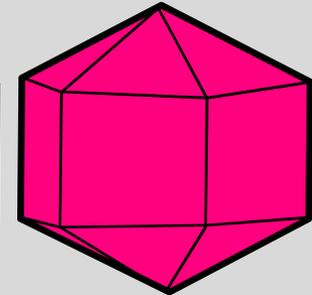
Quartz



BROWN



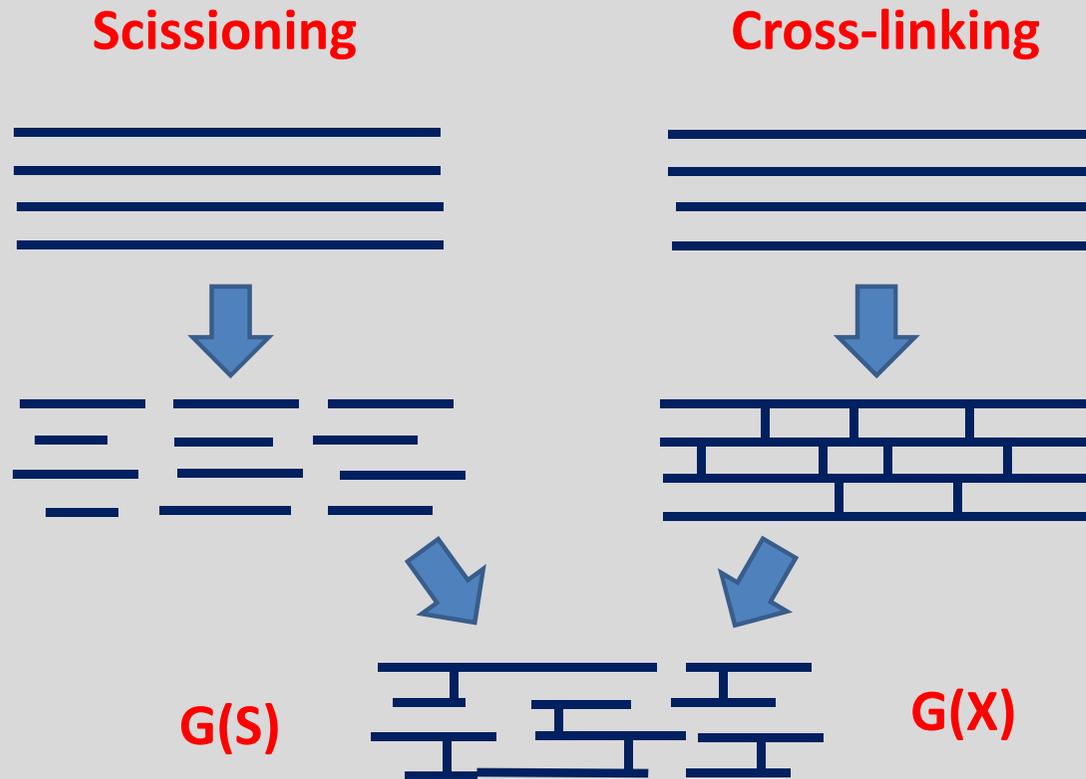
AMETHYST



ROSE

Polymers

Radiation can influence the structure of polymers



Three-dimensional
links between
adjacent
polymer chains

Polymers

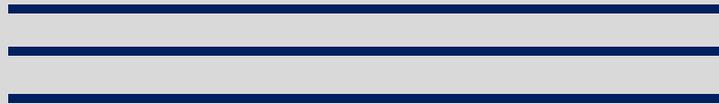
Radiation can influence the structure of polymers

Grafting

Low molecular polymer



High molecular polymer



Backbone polymer chain

Polymers

Insulation jacketing (wires)

Resistant to fire and short circuit

Resistant to chemical solvents

Higher tensile strength

Curing of ink or coatings

The use of volatile organic compounds is not necessary

Tires vulcanisation

Degradation

Teflon to produce powders

Cellulose to produce viscose

Ion selective membranes

Heat-shrinkable tubes and foils

Sterylization

Scissioning the DNA of pathogens (Salmonella and E. coli)

Waste water treatment

Medical instruments disinfection

Food conservation

Kills pathogens and insects

Sprout inhibiting

Delay of ripening

Environment

Flue gas treatment - high efficiency of SO_x NO_x removal

By pass product is fertilizer

Future plans

Tomography

Electron beam applicators

Extra equipment for NDT laboratory

Videoendoscope

Ultrasonic defectoscope

Material science laboratory

Micro-CT, SEM, XRD

Chemical analyser

Hardness testers

Servohydraulic fatigue machines

Maybe magnet

Thank you for
your attention